SIXPENCE

AUGUST 1941

AMATEUR RADIO

THE
OFFICIAL ORGAN
OF THE
WIRELESS INSTITUTE
OF
AUSTRALIA

Published by the Victorian Division

AMATEUR-RADIO

Vol 9. No. 7. August, 1941.

STRAIGHT LINE CALIBRATION

(From an article by W. A. Roberts.)

There always seems to be a certain excitement in calibrating a newly completed wave-meter or radio frequency oscillator. Provided that the instrument has been carefully and stably constructed, its whole value will depend upon the curve which results from those lists of frequencies and dial readings. If the curve is straight, open and of sufficient range, then the work of construction is adequately rewarded.

Very often though the curve is not quite all that may be desired. One of the most frequent troubles is that the plotted line bends seriously. As a result, the ove rall range of the instrument is less than it could have been with straight line calibration and the useful range is restricted.

The cause of this trouble lies in the tuning condenser and in the circuit capacities which are in shunt across the main tuning capacity. Fig 1 is a curve of dial readings plotted against frequency for each of the four main types of tuning condensers which are available. In the order of the diagram the types are:- Straight line capacity; straight line wave length; straight line frequency, and log law or mid-line.

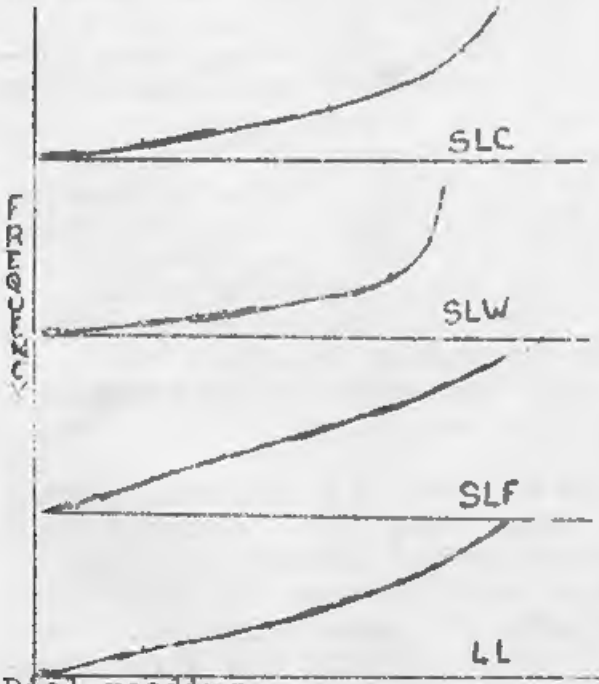

Fig. 1.

These curves show that the first two condensers are quite unsuitable for our purpose, the high frequencies are cramped in relation to the low frequencies.

These two types are in any case more or less obsolete, though there are still plenty to be found in junk boxes. The third type, straight line frequency is the best for our immediate purpose, while the fourth type--the log law--will also serve quite well.

Considering the straight line frequency design, it might appear that with one of these condensers connected across a coil straight line calibration is certain. In practice curve A of Fig. 2 will almost invariably result; it will tip up at the high frequencies and compression will result at the low capacity end of the scale.

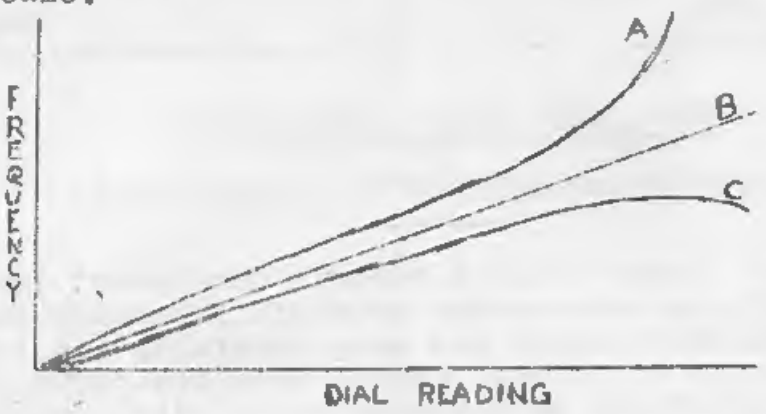

Fig. 2.

The design of any modern variable condenser takes into account the stray capacities which will be placed across it in practical use. Suppose a tuned circuit is to be arranged to give a 2 to 1 frequency variation from minimum to maximum of the condonser, with a straight line frequency law. Then the condenser design must be arranged so that the total maximum capacity is four times the total minimum capacity. Any trimmers which are in the circuit must be taken into consideration.

If that condenser is removed from the circuit for which it has been designed and put into another circuit without the same trimmer and incidental capacities, then the straight line effect will no longer be obtained. Suppose, as is most likely, that the new circuit has lower inherent shunt capacity than that with which the condenser is intended to work. With the plates near the full mesh position the capacity of the tuning condenser is large and the effect of any minor shunt capacity is small. When the condenser rotation has reached such a position that the plates are well out of mesh, the capacity is decreasing to a very low value and the effect produced by the absence of the fixed shunt capacity gets relatively greater and greater. The total capacity towards minimum is less than it should be, the frequency to which the circuit tunes is correspondingly higher, the curve bends upwards at an increasing angle and curve A is the result.

If for some reason too much shunt capacity is present, then the curve will bend downwards at the upper end, for the total capacity there will be higher by a considerable percentage than the capacity required for straight line results, and the highest frequency reached will be lowered accordingly (see curve C). This is the condition which obtains when a tuned circuit has been overloaded with fixed shunt capacity to obtain higher stability.

It is plain that somewhere there lies a happy medium for the value of shunt capacity, and, in fact a little trail and error with a variable trimmer or with different fixed condensers will produce the desired straight line for a curve of frequency against dial readings.

IMPROVING THE CURVE

Turning to the consideration of the low law or mid-line condenser, the same remarks regarding design apply. The theoretical curve will not necessarily be obtained by simply connecting the condenser across a coil and calibrating the circuit. However, using the circuit of Fig. 3, where C1 and C2 are trimmers, it is possible not only to obtain the theoretical curve but to go beyond this and obtain something very close to a straight line result. It will be noticed that this circuit is the same as that used in a superhet to track the oscillator portion of the ganged condenser.

Because the unknowns are so prominent it is not possible to give specific values for the parallel and series trimmers. One can, however, give an idea of the values which will be required, and after that trial and error is advised. First take the calibration curve without trimmers of any sort and see where correction is needed. Choose your correction circuit described previously. Now remember that with the parallel connection the larger correction required, the larger must be the capacity; with the series connection, the larger the correction required, the smaller must be the capacity. Then start connecting some trial values.

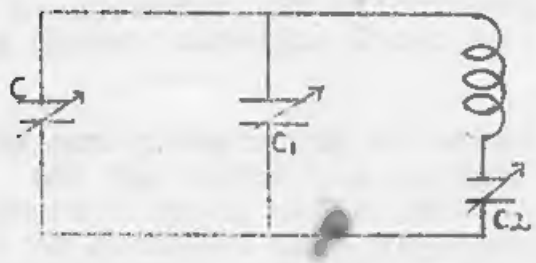

Fig. 3.

With a 0.0005 mfd main tuning condenser, used at wave lengths between 200 and 2 000 metres a parallel trimmer of 50 mmfds maximum will usually meet the case. With 0.00025 mfd as main tuning a condenser half that size will be better. Indeed a 25 mmfd trimmer will be suitable for use with most small tuning condensers.

THE SERIES PADDING CONDENSER

In the case of the series condenser we have said that the smaller the capacity, the larger the correction. At the same time there must be an early limit to the smallness of the capacity, or the resultant total capacity present may not be anything like the nominal value of the tuning condenser--with

NOISE IN CONVERTER VALVES

The following is taken from an article on converter valves published in "Radiotronics"

.....

THE CAUSES OF VALVE NOISE

Valve noise is present in all valves, but is only apparent when the signal input voltage is extremely small. It is thus noticed in the RF amplifier and converter stages of sensitive receivers. In all cases with normal converter types the converter valve noise is higher than that in the RF amplifier, for example a pentagrid converter valve has about four times the valve noise of a typical RF amplifier type. In the RF stage gain is high, the converter valve noise may be neglected in comparison with the RF amplifier noise, since the converter noise is divided by the RF stage gain in order to give the equivalent noise at the grid of the RF amplifier. The resultant noise voltage is obtained by taking the square root of the sum of the squares of the individual noise voltages.

It can be shown that if the RF stage gain is low, as is possible on the short wave band, the converter valve noise is important even when an RF stage is used. In an extreme case where the RF gain is very little above unity the addition of an RF stage may actually increase the total effective noise in the receiver..

In a triode valve, the valve noise is principally due to what is known as the "Shot Effect" and is a function of the plate current. This noise really occurs in the plate circuit, and is therefore divided by the valve gain when referred to the gird. The ideal valve thus has high gain and low plate current.

In a multi-grid valve there is an additional source of noise due to the fluctuating "sharing factor" of the additional electrodes. The ideal pentagrid converter thus has high gain and low plate, screen and oscillator (anode grid) currents. If the oscillator is completely independent of the mixer, as with triode-heptode, the oscillator plate current has no effect on the noise, and this is one reason why a triode-heptode may have a lower noise level than a pentagrid. Radiotron 6J8G is a triode-heptode having an extremely low noise level and for this reason is very popular for use in sensitive receivers. This low noise level is due primarily to the low plate and screen currents, the plate current being about half, or less than half, that of most other converter types, and the screen current being less than half that of comparative types, with the exception of the pentagrid types. The following table compares the electrode current of the best known standard converter types:-

	6J8G	6A8G	6K8G	6SA7	
Plate current	1.3	3.5	2.5	3.4	ma
Screen current	2.9	2.7	6.0	8.0	"
Oscillator Current	x	4.0	3.8	----	
Total Current	4.2	10.2	12.3	11.4	"

X Completely independent of mixer.

Since the valve noise occurs in the plate circuit the stage gain is extremely important. Type 6J8G has a fairly low conversion conductance but a very high plate resistance. In order to obtain high gain, and thus low noise level, it is therefore necessary to use an IF transformer having a very high dynamic resistance (i.e. high Q and high L/C ratio). With a suitable IF transformer a very high gain is obtainable in spite of the low conversion conductance. A high conversion conductance is usually accompanied by high electrode currents and a lower plate resistance and therefore higher noise.

OTHER CAUSES OF NOISE.

The valve is not by any means the only source of noise. A resistance or tuned circuit is also a source of noise which is known as "thermal agitation noise" producing a noise voltage proportional to the square root of the resistance (or dynamic resistance in the case of a tuned circuit at resonance). This noise is considerably greater on the broadcast band than on the short wave bands. On the broadcast band it is normally greater than the valve noise in a receiver having a high gain RF stage, and thus forms an ultimate limit to the practicable sensitivity of a receiver. The resultant noise voltage is equal to the square root of the sum of the squares of the equivalent noise voltage and the valve noise voltage.

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Continued from page 3.

adverse effect on the expected range. The series capacity must be large relative to the tuning capacity, and on the frequencies previously mentioned a suitable arrangement is a 0.002 mfd fixed condensor having a 300 or 500 mmfd trimmer in parallel with it. For the smaller tuning condensers the fixed capacity may be reduced to 1000 mmfd with the same trimmer for providing a range of adjustment.

Finally it is necessary to point out that if the same tuning condensor is used on several ranges, separately adjusted trimmers must be used with each coil. There is no particular difficulty in this. If the ranges are switched, then the trimmers can be switched with the coil; no extra switch contacts are necessary. If separate plug-in coils are used, separate trimmers can be incorporated in the construction of each coil.

DIVISIONAL NOTES

-- Victorian Division --

It is with deep regret that we announce the passing of Flying Officer Murray D. Orr VK3OR.

There was a fair attendance at the annual meeting, and in his Presidential address the President, Mr. H. N. Stevens, VK3JO outlined the Institute's activities for the past year, referring to those who had helped him during his term, and thanked Mr. Jack Kling VK3JB for his efforts in providing a very interesting series of lectures.

The election of Officers for the ensuing year resulted:-

President . .	Mr. H. N. Stevens	VK3JO
Vice-Presidents . .	Mr. T. L. Simpson	VK3ll
	Mr. C. Wadsley	VK3YI
	Mr. T. D. Hogan	VK3HX
Secretary . .	Mr. R.A.C. Anderson	VK3WY
Treasurer . .	Mr. J. G. Marsland	VK3NY
Council . .	Messrs. I Morgan	VK3DH
	T.D. Hogan	VK3HX
	C. Wadsley	VK3YI
	F. Smith	VK3FR
	R. Higginbotham	VK3RN
	H. Burdekin.	

During the balloting for President rather an interesting situation occurred. On the count of votes, Mr. Stevens received 7 votes. Mr. Marsland the same - and there was one informal. On the re-ballot, Mr. Stevens was elected by one vote.

3WQ .. turned up at the meeting -- Some wonder where he has been?

3PW .. now has no worries when the wind blows -- the mast has been taken down and is now safe.

3TE .. has been spending his time constructing an electric clock which is to run on batteries..that's if it goes???

3DH .. as usual has nothing to report except for playing around with the usual home recording.

3RJ .. is feeling miserable over the loss of a round dozen pebbles--all from the upper jaw. That's Ray's version but he doesn't look miserable. Note that he has a couple of stripes up now.

3QZ.. attended his first WIA meeting in spite of being a member for a number of years. At present Graham spends his time keeping the ground transmitters at Laverton on the air.

3DG.. was also present at the meeting. Note also that Dick sports a couple of stripes.

3QV.. says that he's still mucking about with the audio amplifier cum modulators, cum kitchen stove, and hoping...don't know what it's all about but I'm hoping.

3BH.. is from reports still on the farm. Let's hear from you sometime Bruce.

3RN.. is still very silent and refuses to talk. Maybe he finds that crime doesn't pay...or does it???

Ralph Clarkson...is now an engineer at Radio Gippsland 3TR--to which address he has moved his super super receiver and of course himself.

From the RAAF Personnel "Somewhere in Cootamundra" - by 3WD

2AIS..uses a .303 in spare time..maybe..anti as well as pro prachute.

2TQ.. something about "infinity" stop on a miniature camera--wish some of you guys could write properly.

3ZK.. is called the "Phanton" electrician, for reasons unknown??

3FH.. whose radius of action usually includes the local hostel??

4AW.. ex reservist finds himself a long way from VIB.

3WD.. with a debit leave card quoting figures akin to the national debt...Say Bill, why didn't you tell us you were engaged.

The Ballarat Gang:-

3IE.. recently invalided home from the Sunderland Squadron in England after a bad run of luch. Len reckons the huns were out to get him. Tells a wonderful tale of bombs, submarines and all sorts of planes.

3IZ.. is still W/T up in the Sunderlands. Souvenered the safety device from the bomb they sank their first sub with.

3SF.. is serving in Palestine, and appears from letters to be having a good time.

3WD.. was home on leave and celebrated his engagement. What's this about tonsils Bill? and what happened to that 801.?

3BE.. has apparantly been in camp.
3SE.. hasn't had any luck in getting into one of the services.
3AL & 3WA .. are kee ping 3BA on the air.
3ZL.. is not to be found in Ballarat.
3GR.. sells and services radio..meets a few of the RAAF gang.

3DS.. After numerous attempts to get into the Air Force is getting fed up. Now due for military training. Doing a lot of photography.

NEW SOUTH WALES DIVISION

-- By 2TI --

The July General Meeting was held as usual at the Y.M.C.A. Buildings on Thursday 17th ult. The attendance was not as large as usual due to the recent call-up of new age groups.

The evening was devoted to a general discussion as to what direction those members of the Division who were over military age or in reserved occupations could assist the national effort, through the Institute, and several suggestions were made that will be taken up with the authorities.

Federal Headquarters will be located in New South Wales for the next two years--this Division having made an offer to VK3 to relieve them of some of the work that they are now carrying out. New South Wales was of the opinion that it was unreasonable to expect the Victorian Division to function as Federal Headquarters, publish the magazine and attend to their own Divisional matters.

Previously VK2 was of the opinion that no member should hold office in both State and Federal Executives at the same time. This matter was discussed and it was decided that this ruling would be waived for the period of the war.

Amateurs throughout Australia will regret to learn that our old friend Lieutenant D. B. Knock 2NO will be entering hospital to undergo an operation and all his friends will join with Council in wishing Don a speedy recovery.

Congratulations to Con Bischoff 2LZ on his promotion to Sergeant. It is safe to say that 2LZ was the most scientific DX hound in Australia. What Con couldn't make go, well no one could.

Mention has been made previously of hobbies taken up by Hams since the bann on transmissions but one of the most unusual is that of Dave Duff 2EO. You all remember Dave - I think he only worked 40 zones, 48 states and about 150 countries--well dear old "Figgy" is now keeping fowls! Wait till 2ALF and Sid Clarke read this. Dave by the way wishes to be remembered to all his old friends and hopes to be able to get up to VIS one day petrol coupons permitting.

You've of the chap that took delivery of one of those reliance? 22(?) tube Skyraiders the day before war broke out--Well listen to this " I have two Mims Signal Squiters--a two element and a De Luxe Dual Wave. The latter is a three element array for 10 & 20 metre operation. There are no less than six elements in the array...It arrived in Sydney on Sept 4th 1939" Anyone desirous of knowing how it feels to have this lying round the shack is advised to contact Reg Fagan 2RJ.

The next meeting of the Division will be held at Y.M.C.A. Buildings, Pitt St., on Thursday 21st August and the lecture postponed from July will be given by Mr. Frank Hole B.E.B. Sc. and his subject will be "Light".

THE WIRELESS INSTITUTE OF AUSTRALIA

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Meeting Night—First Tuesday in each month.

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N.S.W. DIVISION

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The Division meets on the Third Thursday of each month at Y.M.C.A. Buildings, Pitt Street, Sydney, and an invitation is accorded to all Amateurs to be present.

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